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Review Article

Spotlight on the Novel Coronavirus (COVID-19): A Brief Review

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Abstract

An unprecedented outbreak of the novel coronavirus (SARS-CoV-2) causing coronavirus disease 2019 (COVID-19) has been declared a global pandemic and a threat to public health by the World Health Organization (WHO). This review aims to highlight the current researches on the epidemiology, pathogenesis, transmission and management, clinical features and diagnosis of COVID-19. Researchers are studying a number of potential drug targets for COVID-19. The U.S. Food and Drug Administration (FDA) has granted emergency use of convalescent plasma therapy to treat COVID-19. In the absence of safe, effective and affordable vaccines, the pandemic calls for rapid and accurate diagnostic tools for early detection and management. Significant efforts are underway to develop vaccines against COVID-19.

Keywords: COVID-19, SARS-CoV-2, epidemiology, transmission, diagnosis, vaccines.

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Introduction

The COVID-19 caused by the new Severe Acute Respiratory Syndrome Coronavirus (SARS CoV-2) is currently a leading infectious disease that has rapidly spread across the world. SARS- CoV-2 originated from Wuhan in China in 2019. In January 2020, the World Health Organization (WHO) declared COVID-19 as a major threat and public health emergency of international concern (PHEIC) and on March 11th 2020 declared it as global pandemic (Binti *et al.*, 2020). As of November 30th 2020 in accordance with the applied case definitions and testing strategies in the affected countries, there were 62,757,540 confirmed cases and recorded mortality of 1,460,477 globally as reported by European Centre for Disease Control and Prevention (ECDC, 2020).

In Africa, the spread has been slow compared to other regions of the world due to a reason that is still unclear. The outbreak imposes an additional burden of existing infectious and non-infectious diseases to the already overstretched public healthcare facilities and services, hence further depletion of resources (Kapata *et al.*, 2020). SARS-CoV-2 belongs to a subfamily of enveloped viruses with a positive-sense single-stranded RNA with a genome size of about 30 kb that are known to infect humans (Lu *et al.*, 2020). SARS-Cov-2 together with Severe Acute Respiratory Syndrome Coronavirus (SARS-CoV) and Middle East Respiratory Syndrome Coronavirus (MERS-CoV) are betacoronaviruses that are reported to be highly pathogenic. SARS-Cov-2 strains has a genetic similarity with SARS-CoV and MERS-CoV. In 2003, China reported an outbreak caused by SARS-CoV and in 2012, Saudi Arabia reported the outbreak of MERS-CoV. SARS-CoV-2 is the third outbreak of betacoronaviruses in humans (Kannan *et al.*, 2020; Harapan *et al.*, 2020; Ye *et al.*, 2020). The route of transmission is primarily through human-to-human contact through respiratory droplets. It is important to note that asymptomatic transmission during the incubation period is a great possibility (Li *et al.*, 2020). The envelope spike glycoprotein (S) binds to its cellular receptors angiotensin-converting enzyme 2 (ACE2) where it fuses to the membrane (Ye *et al.*, 2020). Important host factors revealed to determine the virulence and the pathophysiology include but not limited to obesity, diabetes, chronic kidney disease, advanced age, and other forms of known and unknown complications (Temgoua *et al.*, 2020). Critical steps in the diagnosis of COVID-19 case primarily involves symptomatic patients with complaints of any of the following symptoms: fever, cough, shortness of breath, fatigue, headache and/or contact with an infected person and history of travel to epidemic areas (Chanda-Kapata *et al.*, 2020).

However, COVID-19 symptoms in some cases can be non-specific ranging from asymptomatic to severe pneumonia and eventual death (Reed-Embleton *et al.,* 2020). RT-PCR remains the gold standard test even though there are reported cases of false-negative results (Deng *et al.,* 2020). Until now, there is no clinically approved treatment or licensed vaccines for COVID-19 and many proposed drugs are underway for trials (Temgoua *et al.,* 2020).

Epidemiology and Pathogenesis

The current outbreak of COVID-19 is reported to have originated from Wuhan, one of the most populous cities in Southern China from wild animals. Earlier cases were linked to a wholesale market where the virus was claimed to have transmitted from animals to humans even though no confirmed case was associated with animals (Li *et al.,* 2020). The first confirmed index of COVID-19 outside China was reported on 13th January 2020 in Bangkok (WHO, 2020a). In March 2020, WHO declared COVID-19 as global pandemic and a threat to public health, when about 8565 confirmed cases had been reported outside China with 132 deaths, as well as a significant community transmission occurring at an alarming rate across the world (Di Gennaro *et al.,* 2020).

Coronaviruses encode structural and accessory proteins. The pathogenesis of the disease is directly linked to the structural and accessory proteins of the virus. COVID-19 primarily involves cellular receptor of angiotensin-converting enzyme 2 (ACE2), a receptor-binding domain (RBD) of virus spike protein, the protease and potential cross-protective epitopes with respiratory systems as its confirmed pathway (Hao and Bao, 2020). When the virus invades a host, it may pass through the nasal and laryngeal mucosa, then invades the lungs through the respiratory tract. The virus then attacks organs such as the lungs, heart, renal system and gastrointestinal tract that express ACE2 (Chen *et al.,* 2020; Bennardo *et al.,* 2020).

The virus eventually launches another attack that is capable of causing severe damage to the patient's condition between 7-14 days after onset. Under this condition, the patient may experience a reduction in B lymphocyte, which may affect the synthesis of antibody. In addition, the expression of inflammatory factors that are linked with disease contains IL-6, which also contributes to the severity of the disease condition around 2 to 10 days from the onset (Di Gennaro *et al.,* 2020).

Transmission and Management

The relatively high rate of transmission of the novel coronavirus has been the cause of huge interest in the virus and the disease. Person-to-person route of transmission is the most dominant cause of the rapid spread of the novel coronavirus disease which is confirmed through viral infections acquired within a familial cluster (Chan *et al.,* 2020). This route of transmission occurs mainly during close contact or direct contact with an infected person, whereby the infected person's respiratory droplets (from coughing, sneezing, or even mere talking) carrying viral particles land on the mucosal membranes of a susceptible person (Stadnytskyi *et al.,* 2020). The spread of the coronavirus disease also occurs indirectly, whereby contaminated droplets rest on objects which in turn exposes susceptible persons who come in contact with by touching them and then touching their mucosal membranes, they become infected (WHO, 2020b).

Transmission route of COVID-19 virus could also be via droplet nuclei or aerosols (airborne transmission) even though it has not yet been confirmed in some countries. However, evidence has been shown in some recent studies that the virus may also be transmitted through aerosols, under specific circumstances and settings in which aerosol-generating procedures and support treatments are performed. Respiratory droplets that are less than or equal to 5um in size are known as droplet nuclei and can be suspended in the air for a long period of time and be spread to susceptible persons over distances greater than one meter (Prather *et al.,* 2020; La Rosa *et al.,* 2013; WHO, 2020c).

Vertical route of transmission (transmission from mothers to infants) of the virus has not been reported (Antorakou, 2020). According to Nikose and Nikose (2020), arguments on vertical transmission has been addressed and no evidence of vertical transmission has been obtained by the available literature. However, some recent pieces of evidence are suggesting that vertical transmission is possible (Fornari, 2020; Dong *et al.,* 2020).

Faecal-oral transmission of the coronavirus disease has to date not been confirmed, and there is no evidence of transmission of the disease through consumption of food or drinking water. However, there is some evidence that the COVID-19 virus may lead to intestinal infection and be present in faeces of the infected person. The presence of the coronavirus has been found in the stools of a small number of patients with COVID-19. Therefore, the possibility of transmission through the faecal-oral route should not be overlooked but be examined in future researches (Ahmadiara, 2020; WHO, 2020d).

Currently, there are no vaccines or pharmacological treatments for COVID-19. Researchers are studying a number of potential drug targets for COVID-19. Some include antiviral drugs remdesivir, favipiravir and merimepodib, anti-inflammatory drugs such as corticosteroid dexamethasone, prednisone, methylprednisolone or hydrocortisone, anti-inflammatory therapy**,** Immune-based therapy (also callconvalescent plasma). The U.S. Food and Drug Administration (FDA) has granted emergency use of convalescent plasma therapy to treat COVID-19. The immune-based therapy employs the use of blood donated by patients who successfully recovered from COVID-19 infection. The blood is used in the treatment of patients that contract the infection. Other drugs with emergency approval by FDA are malaria drugs hydroxychloroquine and chloroquine that were later withdrawn duetoin-effectiveness and serious damage to the heart**.** Amlodipine, ivermectin, losartan and famotidine are also some of the drugs under study to determine their effectiveness against COVID-19 (Corum*et al.,* 2020). Treatment is mainly symptomatic and oxygen therapy is the most commonly used treatment for the disease in patients with severe infection (Wang *et al.,* 2020). Contact precautions should be used when handling contaminated oxygen interfaces of patients with infection (WHO, 2020b). Different treatment interventions can be used for the management of the disease depending on the severity of the illness (Chang *et al.,* 2020).

Hospitalization may not be necessary for patients with mild illness, unless there is a need for rapid deterioration (WHO, 2020d). Their body temperature, oxygen saturation, blood pressure, and respiratory symptoms should be checked on a daily basis for a minimum of 14 days. Management of such patients should focus on prevention of transmission to others. They should stay at home and try to distance themselves from other members of the household and take preventive measures like wearing of a face mask when in the same room (or vehicle) with other people and when going to health care centers. Frequently touched surfaces should be disinfected (Di Gennaro *et al.,* 2020). Discharged patients should be instructed to return to the hospital in case of any worsening illness (WHO, 2020d).

Clinical Features and Diagnosis

Clinical presentations of COVID-19 primarily include fever, fatigue, dry cough, myalgia, and shortness of breath; however, fever is not necessarily the first presentation and does not arguably indicate the presence of COVID-19 until further analysis determines otherwise (Wang *et al.,* 2020). The clinical manifestations of COVID-19 may range from asymptomatic or symptomatic

forms to clinical states that are characterized by severe respiratory syndrome which often necessitates the use of mechanical ventilation as a support in an

intensive care unit, to organs and systemic presentations such as multiple organ failure syndromes, sepsis, and septic shock (Lupia *et al.,* 2020). Until now, there are no peculiar or pathognomonic clinical presentations that can categorically distinguish COVID-19 from other infectious viral respiratory diseases. Studies revealed that primary symptoms such as headaches, sore throat, rhinorrhea, respiratory symptoms, and gastrointestinal symptoms have also been reported in some patients (Di Gennaro *et al.,* 2020).

The estimated incubation period of COVID-19 is 1-14 days and according to a study conducted in Wuhan on the first 425 people, the incubation period is mostly 3-7 days (Li *et al.,* 2020). The estimated time frame from the onset of COVID-19 symptoms to a death varies between 6 to 41 days and is majorly dependent on the age and health status of the patient. It was reported to be shorter among middle-aged and elderly people with pre-existing health complications (WHO, 2020e; Wu *et al.,* 2020). It becomes imperative for frontline healthcare personnel to give due consideration to the effectiveness of quarantine period based on the most relevant incubation period in order to halt community transmission of infected but asymptomatic individuals to others (Chang *et al.,* 2020). Patients with primary symptoms such as fever and/or respiratory symptoms and acute fever, fatigue, dry cough, myalgia, shortness of breath, even without pulmonary imaging disorder should be examined for COVID-19 (Ye *et al.,* 2020).

Detection techniques that are rapid and sensitive are important for the identification, isolation and management of people with COVID-19. Serological tests like enzyme-linked immunosorbent assay (ELISA) or Western blots are employed to detect specific COVID-19 proteins from samples such as nasal secretions, throat swabs, blood, sputum, and bronchoalveolar lavage (BAL) collected from suspected patients. Molecular diagnostic such as reverse-transcription polymerase chain reaction (RT-PCR), real-time RT-PCR (rRT-PCR), and reverse transcription loop-mediated isothermal (RT-LAMP) remains the standard method for the diagnosis of COVID-19 among many other diagnostic techniques.

The following procedures have been recommended for the diagnosis of people with suspected symptoms of COVID-19 and can be used to determine the status of asymptomatic individuals; samples from sputum, throat swabs, and secretions of the lower respiratory tract is subjected to real-time RT-PCR amplification to detect the presence of COVID-19 nucleic acid (WHO, 2020f). For early detection in symptomatic and asymptomatic suspects, two one-step

quantitative RT-PCR (qRT-PCR) assays were developed to detect two different regions (ORF1b and Nucleocapsid) of the COVID-19 genome

(Zhai *et al.,* 2020). The current laboratory test is time-consuming, and it is capital intensive. It is recommended that patients with suspected COVID-19 symptoms such as fever, sore throat, fatigue, coughing or dyspnea with recent exposure to infection be diagnosed with typical chest computerized tomography (CT) although negative RT-PCR results (Zhai *et al.,* 2020).

In regions with widespread malaria infection, there is a need to rule out the presence of malaria since there are rapid test kits for malaria to avoid unnecessary waste of resources in the diagnosis of suspects with COVID-19. In the event of co-infection, the situation can be managed simultaneously.

Vaccine Development

Vaccines had been used to contain several infectious diseases outbreaks with remarkable success. In the wake of COVID-19 outbreak, the scientific community made tremendous efforts to contain the spread of the disease. After the genetic sequence of SARS-CoV-2 was published in January 2020, multiple intensive efforts have been in place to develop safe and effective vaccines against the disease by the biotechnology industries across the world. SARS-CoV-2 is an envelope positive-sense single-stranded RNA virus with a genome size of about 30kb. The viral structural and non-structural proteins, replication mechanism, genetic material and its pathogenesis are potential targets that are being explored to develop vaccines. A clear understanding of the virus pathogenesis and antigenic structures are important in developing an efficient vaccine (Patel *et al.,* 2020). Like SARS-CoV, the novel SARS-CoV-2 utilize the ACE2 receptor-like and majority of vaccine candidates aim to trigger neutralizing antibodies against the viral spike protein that is critical in attachment, binding, fusion, and entry to host cells thereby preventing uptake via the human ACE2 receptor (Amanat and Krammer, 2020).

Triggering immune response to the SARS-CoV-2 involves the activation of innate immune and specific antigen responses of B and T cells hence, neutralizing antibodies are produced that protects against viral infection a principle that applies to the vast majority of vaccination. It is important to note that several biotechnology platforms are being evaluated in vaccines development. Some of the biotechnology platforms include; Live attenuated and inactivated vaccines where a modified or mutant non-virulent strain of live SARS-CoV-2 is used to induce an immunogenic response, Viral-vector based vaccines where a recombinant molecule is produced carrying a gene of SARS-CoV-2 that is capable of activating cytotoxic T cells to eliminate the

platforms offer great flexibility in terms of antigen manipulation and potential for speed whereas viral-vector based vaccines offer great and efficient protein expression, stable and robust immune responses (Le *et al.,* 2020).

To date, there is no clinically licensed safe and effective vaccine against COVID-19. However, in August 2020, WHO released a draft landscape of COVID-19 vaccines candidates under evaluation at different stages of clinical trial. Hundreds of biotechnology industries and institutions across the world utilize different technology platforms to develop the vaccine candidates. Some of the most advanced vaccine candidates against COVID-19 that has moved into phase I, II and III include but not limited to; a non-replicating viral vector based vaccine developed by University of Oxford/AstraZeneca (ChAdOx1-S), an Adjuvanted recombinant protein (RBD-Dimer) developed by Anhui ZhifeiLongcom Biopharmaceutical/Institute of Microbiology, Chinese Academy of Sciences a LNP-encapsulated mRNA developed by BioNTech/FosunPharma/Pfizer (WHO, 2020g). Considering the fact that there is immediate massive demand to curb the devastating effects of SARS-Co-2 on the global economy and social life, efforts should not be limited to immune based therapy. Novel therapeutic approaches through medical biotechnology, nanotechnology, phage therapy and molecular farming should be considered.

Conclusion

This review highlights the current research on COVID-19 pandemic and the efforts in place to contain the outbreak which has become a threat to public health. There is a need to increase surveillance through the establishment of a rapid response teams to oversee and manage the outbreak so as to effectively contain and prevent community transmission. Currently, there are no clinically approved vaccines or biologics for COVID-19. Individuals are encouraged to practice social distancing, isolation, use of face mask and good personal hygiene through frequent washing of hands. SARS-Co-2 is the third outbreak of coronaviruses in the last two decades. The possibility of future outbreaks cannot be entire rule out.It is important to strengthen the healthcare delivery system against future possible outbreaks and to develop vaccines/antiviral drugs against the COVID-19. We therefore encourage collaborations amongst relevant stakeholders and individuals so as to contain the menace of COVID-19 against humanity.

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